National Weather Service

Report of the Aviation Products and Services Tiger Team

PREDECISIONAL AND DELIBERATIVE

December 16, 2005

Foreward

This report was produced by a team of National Weather Service employees chartered by the National Weather Service Corporate Board (see next section) and provided to the Board for its further deliberation and action. Therefore the report itself is a deliberative, pre-decisional document – all further actions taken based on this report will be the result of decisions made by the NWS Corporate Board. The report is being published in the interest of transparency to provide NWS employees and other interested parties insight into the development of NWS plans.

CONTENTS

National Aviation Initiative
Securing Our Role in the Provision of Aviation Products and Services
Team Charter
August 25, 2005

Problem Statement:
The National Weather Service must improve and enhance products and services to meet the increasing expectations of a valued federal partner (FAA).

Goals and Objectives:
To make aviation services the model for our relations with other federal agencies. This initiative directly moves NWS toward its future goal of being *the* federal source and provider of weather and environmental information.

This team will develop a strategy to secure NWS's role regarding aviation services and identify immediate activities to improve aviation services. This plan will support the safe and efficient use of the National Airspace System.

Scope:
Guiding Principles
- No degradation of service
- Equitable services across the nation
- Cost effective
- Do not address grade structure, staffing levels, office size, org-chart
- Solicit input from the workforce in accordance with the CBA
- Test key features within 18 months
- Be sensitive to future and vision of the Joint Planning and Development Office.
- Do not wait for the FAA to develop a specific set of requirements
- Forecast production options must take into account the CON OPS
- Collaborate extensively with the two other team initiatives: IT Consolidation and NWS CON OPS.

Must Address:
- All products and services in support of aviation safety for possible improvements and redesign.
- Possible changes to the roles of different parts of NWS providing aviation services.
- R&D activities critical to NWS aviation services.
- Previous aviation teams' efforts and recommendations.

Roles and Responsibilities:
Director:
- Chair reports directly to Director.
- All major problems will be resolved here if not before.
- Final approval authority for charge, charter, and team output.
- Maintains 51% of Board voting authority.
- Maintaining communication of progress w/ NOAA as appropriate.

Corporate Board:

- Remains intellectually engaged with Tiger Teams.
- Advisory role maintained mainly through the Team Champions.
- Available to team chairs for advice and/or resources if called upon.
- If first level supervisor to a team member, role is limited to advisor and to fully support (resources) as necessary.
- Upon delivery, role is to review/advise on delivery.

Champion:

- First Board level support to team chair and team.
- Liaison between Corporate Board and team chair.
- Help ensure resources are provided as necessary.
- Role limited to supporting/advising and enabling the team, not managing or directing
- Ensure three Teams efforts are integrated.

Chair:

- Responsible for the Team, and final deliverables.
- Reports to the Director at pre-set intervals, between as necessary.
- Seeks advice from Champion.
- Communicates to the Board through the Champion, and through pre-set briefings.
- Ensure three Teams efforts are integrated.
- Provides deliverables as scheduled.
- Solicits input from the field using COM office or other means.
- Has this task as their number 1 priority.

Tiger Team:

- Report to Chair.
- Works as a team with Chair to develop all deliverables.
- Has this task as their number 1 priority.

Key Objectives and Timeline:

Produce a draft plan by November 15, 2005, and brief the Corporate Board by December 1, 2005. The final plan will be completed on or near the termination date. The team will be dissolved on or about December 16, 2005. Additionally, the Corporate Board Champion and Initiative Chair may continue to assist in editing of the report beyond the termination date.

AVIATION "TIGER" TEAM

Tom Amis	Meteorologist-In-Charge CWSU, Fort Worth, TX
Mark Andrews	Weather Integrated Product Team Lead Joint Planning and Development Office, Washington, DC
Scott Birch	Regional Aviation Meteorologist NWS Western Region Headquarters, Salt Lake City, UT
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Team Champions:

Laura Furgione	Director, Alaska Region, NOAA's NWS
Bill Proenza	Director, Southern Region, NOAA's NWS

Executive Summary

The Aviation Initiative Tiger Team was chartered by the Director of the National Weather Service (NWS), Brigadier General D.L. Johnson, USAF (Ret.), to develop a strategy to "*secure our role in the provision of aviation products and services*" in the future. The team identified three key strategic initiatives to be addressed:

1. Forecast Process:

The current forecast process is not as strong as it needs to be for the NWS to produce, present, relay, and manage an accurate, consistent, and relevant suite of aviation products and services. Forecast responsibilities are spread across Weather Forecast Offices (WFOs), Center Weather Service units (CWSUs), and the Aviation Weather Center (AWC) and Alaska Aviation Weather Unit (AAWU). The current process limits NWS forecasters at every level of forecast production to some degree. Each entity uses different forecast production systems based on organizational affiliations that limit collaboration and, through differing capabilities, lead to a degree of inconsistencies between products issued by different entities. Current CWSU staffing is funded at "one-deep" challenging the forecaster's situational awareness during times of high impact weather. The CWSU is further limited by having the least capable of the three forecast production systems. WFO forecasters must meet the needs of several high priority NWS programs simultaneously, with aviation many times relegated a lower priority task than the focus on severe weather. Finally, AWC/AAWU forecasters do not have an efficient method for collaborating with WFOs and CWSUs and integrating information produced at the other facilities. These limitations affect the ability of the NWS to present a consistent suite of forecast products and services to the National Airspace System (NAS).

The team proposes a consolidation of CWSU and WFO aviation responsibilities under the auspices of several Air Transportation Weather Offices (ATWOs) in order to enable NWS meteorologists to maintain a high degree of vigilance and flexibility in providing aviation weather support to the NAS. Further, the team proposes the deployment of a standard forecast production system, which includes collaboration tools, to enable a coherent and consistent delivery of products to the NAS. The team recommends five prototyping activities which together will provide the data needed to fully develop the ATWO concept.

2. Integration of Research into Forecast Operations:

Through its Aviation Weather Research Program (AWRP), the Federal Aviation Administration (FAA) has spent millions of dollars to develop new weather forecast products to mitigate weather impacts on air traffic flow in the NAS. Most development occurred under the assumption that generating new forecasts and products would be a fully automated process. None of these new products has been declared a "primary" product by the FAA for use in operational decision making. The FAA and NWS reassessed the assumption of full automation and have developed a strategy to involve the human in the process of generating these new products, including graphical forecasts of convection, icing, and turbulence.

The team believes NOAA is well-suited to assume management of research, development, and the operational transition of new aviation products in support of NAS operations as a long-term strategy. NOAA/NWS has an extensive history working in the interface between its customers and the research and development community. NOAA/OAR manages the extensive applied research programs that span the needs of NOAA's customers and partners. Both NWS and OAR have been working very effectively within the current context of the AWRP. Two of the prototype plans recommended by the team couple the human with the automated process to improve short-term forecasts for convection and icing. These efforts will also merge multiple, inconsistent products.

3. Management of Aviation Program:

Management of the NWS aviation program spreads across the organization. Terminal Aerodrome Forecast (TAF) production is managed ultimately by 122 separate WFO Meteorologists-in-Charge (MICs), who in turn are guided by six Regional Aviation Meteorologists (RAMs). The RAMs themselves are tasked with multiple programmatic responsibilities. CWSUs are co-managed by FAA Air Route Traffic Control Center (ARTCC) supervisors and typically by the MIC of the most proximal WFO. The AWC is managed by NCEP and the AAWU is managed by the Regional Director of Alaska Region. Research, development, and training are managed through NWS Office of Science and Technology. Finally, the Aviation Services Branch (ASB) of the NWS Office of Climate, Water, and Weather Services is responsible for overall program stewardship and the Branch Chief is currently the NOAA Aviation Weather Program Manager with respect to the Program Planning, Budgeting, and Execution System (PPBES). This management structure may limit NWS' ability to meet evolving needs of both operators (FAA) and users of the NAS.

The team recommends NWS use an external group to examine overall management of the Aviation Program, including the CWSU component, and recommend changes/efficiencies in the management of the program, if appropriate.

The team factored efforts of the *Joint Planning and Development Office* (JPDO), an interagency team including Department of Commerce (DOC), Department of transportation (DOT), National Aeronautical and Space Administration (NASA), and Department of defense (DOD), tasked to develop the Next Generation Air Transportation System (NGATS). A key component of NGATS is the idea of a rapidly updated 4-dimensional weather information database to allow both operators and users to negotiate flight plans based on a common weather situational awareness. Implementation of the 4-D database is to begin by 2012

Together, these three initiatives: a consolidated, flexible and focused forecast process, taking a key role in the operational integration of FAA weather mitigation research and by undertaking a full assessment and realignment of aviation program management will secure the NWS as a current provider of weather products and services to the NAS now and as we evolve to the NGATS.

These initiatives are a guide for prototype efforts to establish resource requirements, workload assessments, and procedures, as well as determining required changes to appropriate research, development, transition into operations, and training.

Implementing these initiatives will improve the aviation program and meet FAA demands for improved, more efficient services.

In designing this plan, the Team considered previous work performed by NWS and FAA—specifically the November 2003, FAA and NWS Functional Audit of CWSUs; the December 2003, NWS Tiger Team that developed a Concept of Operations (CONOPS) for enhancing CWSU services; and the most recent team initiative organized in April 2004 to examine end-to-end NWS services in support of aviation.

1. Current State: Present Condition – How NWS Operates Today

This section summarizes current NWS aviation operations. Detailed information on aviation operations and products is in Appendix A. As a whole, the team believes elements of the core forecast process supporting aviation needs to be strengthened. The core forecast process defined here includes resources (people and technology) and the organization and management of these resources required to produce and provide accurate, timely, consistent, and relevant information.

The FAA is **the** Meteorological Authority for the NAS. This is a very different relationship than other NWS service areas in that they establish the policy and procedures for the provision of the weather information for the NAS. In addition, they have an agreement with the NWS for the NWS to provide meteorological services—specifically the CWSU operation. With a 90 day notice, the FAA could terminate this agreement.

Through its WFOs, National Centers, and CWSUs, NWS provides a wide range of aviation products and services in the form of warnings, forecasts, meteorological consultation, training, and outreach. The primary aviation forecast product issued by the WFOs is the TAF. The CWSUs primary mission is to improve safety and enhance efficient flow of air traffic by forecasting and monitoring adverse weather within the ARTCC. The AWC and AAWU provide dedicated aviation services for the CONUS and Alaska, respectively. The AWC is designated as a World Area Forecast Center and produces products that span the globe. AWC and AAWU and the Honolulu WFO are also designated Meteorological Watch Offices (MWO) for the International Civil Aviation Organization (ICAO).

WFOs have a variety of customers and provide multiple forecasts and services for different programs (i.e. fire weather, marine, public). WFO forecasters divide their time between each of these programs within the office.

WFO forecasters must balance many programs at once (multiple number one priorities), and, given CWSUs are frequently staffed by one forecaster on duty, and rarely if ever, provide 24 hour operations, CWSU forecasters cannot always keep their “eyes on target” when weather is most critical. This leads to an aviation forecast process that is lacking consistent, accurate, relevant weather information, and contributes to low trust and confidence by NAS users of the weather information NWS provides.

Systems currently in service for producing aviation weather products include the Advanced Weather Interactive Processing System (AWIPS), the Advanced Weather Interactive Processing System for National Centers (N-AWIPS), the Weather and Radar Processor (WARP), the Aeronautical Information System Replacement (AISR), and separate, dedicated systems. The system, on which an NWS aviation weather product is produced, depends primarily on the organizational affiliation of the issuing office and unique requirements at each location. Each production system has its own characteristics, infrastructure, development organization, support provisions, and system management. These different, non-standard NWS and FAA systems add to the inconsistent products and services. Most products and information are generated as text, making interpolation to graphical form crude. Independently created NWS products lack coordination and lead to differing forecasts and confused users.

Accuracy of NWS products is becoming increasingly important to our users. In the late 1990s, NWS began verifying aviation forecasts for icing, turbulence, low ceiling and visibility, and convection forecasts. Improving these and other forecast elements are used as drivers to improve the aviation program as our performance statistics do not meet FAA stated needs.

Existing research, development, and transition to operations (RD&T) efforts are accomplished through the FAA's Weather Research Program and transitioned into operations through the NWS Aviation Weather Technology Transition (AWTT) process to smoothly transition new capabilities being developed by the FAA's various Product Development Teams into NWS operations. However, the past FAA tendency has been toward total automation of product generation, and implementing these "supplemental" products into both NWS and FAA operations is disjointed and not as efficient as it needs to be.

The management of aviation weather related activities is fragmented and not as strong as it should be--both in the NWS and the FAA. One key issue of contention is the reporting structure of the CWSUs. Management and oversight responsibilities of the CWSU are not consistent with the tasks and responsibilities of the CWSU. For example, an ARTCC airspace responsibility spans several (as many as 10) WFO County Warning Forecast Areas, yet a CWSU reports to a single WFO MIC.

The current cost of the NWS aviation program is difficult to determine. The FAA funds 84 CWSU meteorologist positions at the 21 ARTCCs and reimburses the NWS approximately $12M/year for labor costs. The FAA also funds the Weather and Radar Processor (WARP) system and associated communications/vendor cost (cost not identified here). The NWS aviation program funds 85 FTE positions (includes 6 contractors) that reside at the AWC, AAWU, NWS Headquarters and one each at the Region Headquarters. This labor cost is also approximately $12M/year. In 2003, NOAA began a multi-year effort to improve aviation services funded at $2.5M/year (FY03-FY05) and it increases to $3.5M in FY06. This is also included in the overall NOAA Aviation Program. Labor and infrastructure cost of doing aviation related activities at WFOs and the infrastructure cost for systems and NCEP Centers is not included in the NOAA Aviation Program. Approximately 20% of labor cost at the WFO supports aviation related tasks/responsibilities. This seems reasonable in that all WFO's provide aviation related forecasts during 366 shifts per day.

In sum, the current forecast process needs improvements to assure information that is consistent, accurate, relevant, responsive and contributes to trust and confidence in NWS weather and information products by NAS users of weather information. The aviation team also notes there are “Islands of Excellence” in the NWS that perform aviation-related tasks very well and these are illustrated as key examples on how to move NWS forward.

2. Case for Change: Driving Forces – Why NWS Must Change

Federal Agencies are facing a challenging budget climate which affects both NWS and the FAA. Both agencies must adjust internal priorities and focus to meet the current budget challenges.

The FAA, one of the NWS' longstanding customers, is considering alternatives and options to better support their mission critical activities and is questioning the relevance of NWS products, information and services to the aviation community. At the same time, the FAA is seeking efficiencies and is listening to other weather providers who are challenging NWS' longstanding position as the primary source for aviation weather products and services. In August 2005, the FAA informed the NWS of its desire to cut CWSU funding by at least 20 %. Furthermore, the FAA requested 24 hour, seven days a week, forecast products and services for the ARTCCs. NWS must meet these requirements or lose the funding for the CWSUs. This must be addressed immediately.

For future aviation operations and services, the Joint Planning and Development Office (JPDO) is tasked with building the NGATS. This multi-agency (DOT, DOD, DOC, DHS, NASA) team objective is to develop a system-wide capability to reduce weather impacts on the NAS. Core to this objective is the transformation of aviation products—specifically a 4 dimensional digital database of aviation elements by 2012. Changes to the current NWS system are imperative in order for the NWS to strategically position and prepare itself for full participation in this and other future aviation mission oriented activities.

The NWS must become more responsive and secure its role in providing aviation products, information, and services through rekindled relationships and multi-agency collaboration processes**.** This will also support commercial aviation partners as they struggle in the current economic situation while further improving NWS products, information, and services as a whole. WFOs have too many number one priorities from numerous NWS programs, and aviation forecasting ranks low in priority. This is often evident in the inconsistency and irrelevance of the TAF, given rapidly changing weather conditions. CWSU staff is required to respond to on-demand weather questions, especially questions regarding weather critical to air operations within an ARTCC. As soon as this occurs, the forecast process begins to break down with no "eyes on target" performing, since the only person per shift is required to provide the on-demand service, and cannot perform a continuous meteorological watch.

The numerous FAA/NWS IT systems used to support aviation services add to the disjointed services provided. NWS products created independently by the different aviation service entities in the NWS (CWSU, WFO, AWWU, AWC) lack coordination and lead to differing forecasts and confused users.

Lastly, the past FAA tendency in Research and Development has been toward total product automation having no person involved in product generation. This has lead to a disjointed implementation of these “supplemental” products into operations, and does not dovetail with the NWS vision of “forecasters in the loop” process.

To assure NWS is relevant and important, we must ensure our forecasts and services add value to the process and meet the needs and requirements of our users.

3. Future State: Providing Premier Services – How NWS Sees the Future

The future state of aviation weather will be much improved. First, a strong, more agile forecast process will bring the right resources at the right time and the right place to provide the NAS customer with relevant, accurate, consistent, and timely information. NWS meteorologists will have the training to understand and promote the aviation mission. Technology will be common across all forecast echelons within NWS and will be able to incorporate the R&D being developed through the Federal Government's weather research program. Management structure will adapt and embrace change for improvements and will be accountable to execute the mission successfully.

The Aviation Team strategy describes a framework for improved, standardized, and relevant NWS operations supporting the NAS through implementing three strategic initiatives 1) improving the forecast process focused on aviation; 2) improving the integration of research, development and transition to operations (and associated training); and 3) improving management of the aviation program. Additionally, it is a guide for prototype efforts to establish resource requirements, workload assessments, and procedures, as well as determining required changes to appropriate research, development, transition into operations, and training. Implementing this plan will improve the aviation program and will meet the FAA demands for improved, more efficient services.

The Aviation Team strategy identifies the Air Transportation Weather Office (ATWO) as the foundation for improvement. The ATWO integrates aviation operations and services currently performed at WFOs and CWSUs. In addition, the strategy provides details to improve products from the AWC and AAWU and the Honolulu WFO (designated Meteorological Watch Offices (MWO) for the International Civil Aviation Organization (ICAO)).

3.1. Improved Forecast Process

A significant change for the future state forecast process to improve aviation products calls for a consolidation of the production tasks for terminal (TAFs) and en-route/approach/departure forecasts currently done at WFOs and CWSUs. In this design, ATWOs provide all TAFs and Airport Weather Warnings, perform current CWSU services remotely or face to face, and generate new Tactical Decision Aids (TDAs) for the TRACON and Terminal locations that translate weather information to impacts on operations (i.e., more relevant products). In addition, the ATWO(s) will perform routine collaboration with the AWC, the AAWU, and WFOs on the development of aviation forecasts. The team feels strongly the ATWO forecast process requires a concentration of mass of forecasters focused on aviation duties -- not shared between other NWS service programs.

Core to the improved forecast design is a standard production system that allows for the collaboration described above. Integrating CWSU and WFO aviation functions into the future NWS CONOPS immediately improves forecast operations for aviation by having NWS personnel work with the NWS standard production system. This would also reduce training requirements while building a more viable career path for NWS personnel. This standard system will also support the dissemination of weather information, products, and services to the FAA and other aviation users.

ATWOs will be organized, if possible, to where both weather and air traffic operations have a major impact on the day-to-day execution of the NAS. The table and figure below indicates the highest impact locations given a simple weighted factor that includes the amount of air operations and the amount of time specific weather conditions occur that impact capacity and safety thresholds.

30 airports

Weather impact and air traffic

Ranking of Summed Weighted Frequencies (by impact and air traffic)											
Rank	Site ID	Summed Weighted Impact Factor	Rank	Site ID	Summed Weighted Impact Factor	Rank	Site ID	Summed Weighted Impact Factor	Rank	Site ID	Summed Weighted Impact Factor
1	ORD	638.94	9	MSP	496.55	16	IAD	433.94	24	SEA	359.79
2	ATL	601.34	10	IAH	494.51	17	CVG	421.28	25	LAS	334.81
3	DFW	563.71	11	EWR	493.4	18	BWI	414	26	PHX	327.51
4	DEN	549.76	12	BOS	481.07	19	MDW	412.58	27	MCO	314.92
5	STL	544.16	13	PHL	476.82	20	PIT	398.45	28	MIA	313.39
6	CLT	526.49	14	LGA	455.85	21	JFK	394.37	29	SFO	313.3
7	DTW	517.83	15	SLC	455.59	22	LAX	382.85	30	DCA	252.57
8	MEM	509.58				23	CLE	362.57			

Table 1. Ranking of Summed Weighted Frequencies of Air Operations and Weather

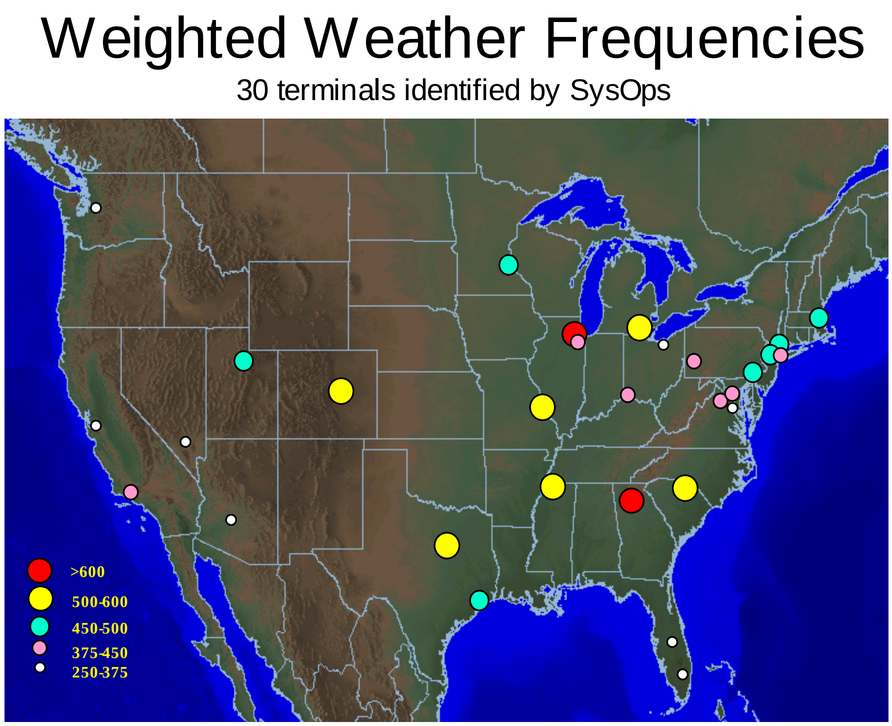

Figure 1: Visual of Table 1

The ATWO construct meets the guidelines provided by the FAA for more relevant information while attaining efficiencies. The resulting improved forecast process (operations and services) will enhance consistency, relevancy, accuracy, coordination, and timeliness of aviation weather information generated by ATWOs, AWC, and the AAWU. Furthermore, this streamlined forecast approach will position the NWS for future (within the next 5-7 years) evolution to support the rapid and continuously updated 4-dimension aviation-element, digital data set required by the NGATS being developed by the JPDO.

NOTE: Key elements of the ATWO prototyping must be proven and subsequently supported by the FAA and the NWS. For example, if the CWSU is no longer co-located at an ARTCC, on-demand requests from the FAA must be supported remotely.

The plan calls for a time-phased approach that begins with prototyping as defined in the next section of this report. Follow-on phases as described below will be needed after successful prototyping periods.

<u>Proof-of-Concept and Advanced Product Implementation</u> – Timeframe: estimated to be 2006-2008.

The initial phase focuses on prototyping the ATWO concept and product improvements that can be readily implemented based on NWS and FAA coordination on specific needs, requirements, and programmatic strategies. This phase envisions early pay-off improvements through prototype and Internet displays that also prepare the way for integration into the NAS.

<u>Establishment of ATWO(s) and Improved Integration of Weather Information into NAS Decision Making</u> – Timeframe: estimated to be 2008-2012.

This phase provides the opportunity to integrate new NWS production processes (ATWO performing current WFO and CWSU aviation related products) and new products, including Tactical Decision Aids, into FAA processes and systems. Supporting activities include joint FAA-NWS coordination and resolution of transition issues related to interfaces, product dissemination, format, or content.

<u>Transition to NGATS JPDO Capability</u> – Timeframe: estimated to be 2012-2015.

End State phase encompasses future planned innovations including the national/interagency aviation weather information database currently being planned by the JPDO. Using real time information in the database, all air traffic decision makers will have a much greater and common operational picture of weather and the impact to the NAS.

3.2. Improved Integration of Research, Development, and Transition:

The second strategic initiative is a core principle for enhancing the future aviation program. As we move into the future to support the NGATS, NOAA is accountable to lead the research, development, transition to operations, and training activities (RD&T) required for aviation weather. Initial discussions with FAA officials have been encouraging in support of this new structure.

The rationale for this initiative considers the FAA as a consumer of weather information to successfully orchestrate the execution of the NAS, and NOAA, through the NWS, is the expert provider of operational information, products and services. NOAA should have the end-to-end responsibility to provide weather information critical to aviation, which includes the management of R, D & T. Currently, the FAA manages the bulk of aviation weather R&D within the Federal Government. Often there are significant operational issues transitioning R&D into operations. For example, the FAA R&D program is delivering to the NWS an automated 2 hr convective forecast, covering the CONUS, which is in the time domain for the SIGMET. However, but there has been no coordinated effort to ensure this new product is incorporated into the SIGMET. This organizational change in accountability would facilitate a smooth, rapid, less costly transition of R&D into operations compared to existing processes.

NOAA must step up to the aviation mission and build trust and confidence with the FAA. Benefits of this structure must be evaluated and verified. Furthermore, no growth in the overall Federal budget requires transfer to NOAA of this budget activity from the FAA.

3.3. Improve Aviation Management

The last strategic initiative identified by the Team is to improve NWS Aviation Program management. The team had a wide range of views on what is the most effective management structure for the aviation program. Views ranged from status quo (with improved management oversight) to make one person accountable.

Similar to the forecast process, the aviation team believes management of aviation weather related activities is fragmented and not as strong as it should be--both in the NWS and the FAA. (This plan only addresses NWS activities). Management of day-to-day execution of aviation warnings, forecasts, meteorological advice and consultation is through the efforts of its WFOs, National Centers, and CWSUs. Management of aviation related policies and procedures is done at National and Regional Headquarters. The NOAA Aviation Program Manager within the NOAA Planning, Programming, Budget, and Execution System (PPBES) process plans, programs, and executes a program that involves limited portions of the resources required to provide aviation products and services. Management and oversight responsibilities of the CWSU are not consistent with the tasks and responsibilities of the CWSU. For example, an ARTCC airspace responsibility spans several (as many as 10) WFO County Warning Forecast Areas. Yet the CWSU reports to a single WFO Meteorologist In Charge (MIC).

Given the relatively recent change in NOAA incorporating the PPBES; the recommended ATWO CONOPS to improve aviation weather information, products and services; and the core principle to transfer aviation R, D & T accountability to NOAA, the team recommends conducting an independent assessment to determine the best management structure for the Aviation Program. Such an assessment would examine the existing NWS management structure of the aviation program and identify potential alternative management approaches, if appropriate. As we move forward with the new comprehensive NWS CONOPS, this assessment could also be a path-finding effort for other functional/service areas within NWS.

4.3. Alternatives Considered:

The team considered many Aviation Organization and Forecast Process Designs including (designs in bold are recommended to-be prototyped):

- Status Quo
- Centralization
- **ATWO, AWC, AAWU provide info/services, other WFOs do local outreach**
- **Modified ATWO--ATWO without TAFs (WFOs retain TAFs)**
- ATWO with CWSU functions and 35 hub TAFs

- Decentralize AWC/AAWU Operations to ATWO and WFO

The team believes the best design is for the ATWO, AWC, AAWU to provide information/products/services, while WFOs conduct local aviation related outreach.

Note: Two dissenting opinions were voiced concerning the proposal to move all the TAFS and AWWs from the WFO to the ATWO.

The modified ATWO where the WFOs retain TAF production was supported by the two dissenting opinions and is worthy of a prototype effort.

The goal of prototyping the ATWO and the Modified ATWO is to determine the optimum concentration of people and technology needed to produce the required information. This will enable NWS leadership to determine the optimum number of ATWOs and the viability of having ATWOs produce TAFs and other products, information, and services.

4. The Way Forward: Path to NWS Future – How NWS Gets to the Future

The team recommends prototype efforts be completed over the next 15 months. Specific details of the prototype plans are in Appendix B. There are several critical components of the ATWO prototyping plan that need to be "proven" and supported by both NWS and FAA leadership prior to the operational implementation/transition of the plan.

4.1. Prototyping the ATWO and the improved forecast process includes testing 5 major activities:

1. Improved Terminal Forecasts
2. Improved Collaboration
3. Production of Terminal/TRACON Decision Aids
4. Development of Remote Briefings
5. Improved 0-2 Hour Convective Forecasts

Each of these major activities is described in detail in this Plan, with information provided on each of the following elements:

- Activity Objective
- What will be done (including required IT and other dependencies)
- How it will be done (including locations, duration)
- Projected Milestones
- Training
- Performance Assessment
- Costs

Prototype Locations: For all prototype activities, the Team proposes that the prototype facility be the Dallas/Ft. Worth CWSU, and the Ft. Worth WFO. Both the Dallas/Ft Worth CWSU and Ft Worth WFO have much of the equipment already in place that will support the prototype and this will help reduce cost. The Dallas/Ft Worth air space region will be prototyped. The team also recommends that other air-space regions (i.e., Chicago or Northeast Corridor) also be prototyped. This could be done simulated from Dallas/Ft Worth or physically in-place within the respected area. The team understands cost is a driver with additional in-place locations needing to be equipped and manned.

Duration: The prototype activities will be conducted over four multi-week test periods: Apr-May 2006, Aug-Sep 2006, Jan-Feb 2007, and Mar-Apr 2007. The first test period is to allow as much information to be gathered early in the R&D effort to validate science and technology requirements during the 2006 spring convective season. The remaining test periods are to allow testing with increasingly robust techniques and infrastructure in the summer 2006 convective season, the winter 2006-2007 season, and the spring 2007 convective season.

Each test period will be evaluated in the interim periods in order to make any necessary adjustments to requirements, techniques, and software/hardware infrastructure.

Projected Milestones:

1. Jan 1 – Mar 31, 2006:
    a. Start needed R&D, software development, hardware procurements
    b. Identify personnel and begin training
    c. Deploy required hardware, software
2. April - May, 2006:
    a. Conduct first prototype for all activities
    b. Evaluate hardware, software and forecaster performance, validate science requirements and assumptions for R&D, and make adjustments accordingly
3. August - September, 2006:
    a. Conduct second experiment during convective weather season.
    b. Re-evaluate and make necessary adjustments.
4. December, 2006 - January, 2007
    a. Conduct third experiment during winter weather season.
    b. Re-evaluate and make necessary adjustments.
5. March - April, 2007
    a. Conduct fourth experiment during spring convective season.
    b. Assess results
    c. Evaluate overall performance – integrity as part of ATWO ConOps.

Performance Assessments: The prototype activities will each be evaluated using a mix of objective and subjective measures. Some activities can be evaluated using traditional measures (e.g. POD, FAR for TAFs); others will require an assessment of perceived impact and relevance (e.g. remote briefings, collaboration). The Team recommends that the newly-formed National Performance Management Committee (NPMC) assist in the development of an overall Performance Assessment plan for the prototype activities. In some cases, OAR/GSD will also be able to assist in the development and execution of assessment activities.

Some specific performance assessments have been recommended for consideration by the Team, as follows:

For Improved Terminal Forecasts:

1. Accuracy / Reliability: The differences in POD, FAR, biases between official and experimental forecasts for the categories of IFR, and fuel alternate minimums.

2. Reliability / Consistency: Lead time of IFR or convective weather conditions. The degree to which similar weather situations are handled similarly in terms of TAF content and follow-on amendment strategies.
3. Consistency: The terminal forecasts agree well with other aviation forecasts such as AIRMETS/SIGMETS, and area forecasts.
4. Relevance: Regular evaluation and feedback from FAA, Airline Dispatch, and GA participants as the experiments progress.
5. Efficiency: Up front cost versus future savings.
6. Efficiency: Comparison of new production cost estimates to current production cost estimates.

For Improved Collaboration:

1. The efficient use and sharing of objects in digital format.
2. Evaluation of the impact of collaboration to update Airmet/Sigmet, Convective Sigmet, and other collaborative products.
3. Ability of multiple forecasters to communicate and coordinate

For TRACON/Terminal Decision Aids:

1. Decision Aid consistency, relevance, and accuracy for the NAS customers.
2. Evaluation feedback from FAA, Airlines, and NBAA participants.
3. Cost estimates for new product production.
4. Utility of Web Portal to view Decision Aids
5. Timely product delivery to Web Portal

For Remote Briefings:

1. Evaluate Web Portal for functionality, relevance, and ease-of-use
2. Evaluate the adaptability, relevance of the Remote Briefings to meet the needs of multiple customers

For Improved 0-2 hour Convective Forecasts:

- Real time feedback should be provided to the forecasters during the forecast process. Feedback would be in the form of statistical trends (bias, forecast errors, etc.) and graphics that would provide useful information for correcting future forecasts (Global Systems Division (GSD)).
- An objective measure of forecast skill with and without the forecaster in the loop would be measured and the results summarized in a report (GSD).
- Subjective feedback would be gathered from the FAA, Airline Dispatch, and GA participants as to the improvement in forecast performance and forecast usefulness and summarized in a report (National Center for Atmospheric Research (NCAR)).

Managing the ATWO Prototype

To successfully plan and conduct the prototype activities, as well as manage the associated research, development, and training elements, the Aviation Team recommends the following:

- An ATWO Prototype Team be formed immediately upon Corporate Board approval of the Team's overall Plan;
- A Training sub-team be formed as part of the ATWO Prototype Team to begin developing requirements and content for the various training components of the prototype plan; and
- An ATWO Prototype Project Manager be designated to manage the activities involved in the Prototype design and implementation. Given the skill sets required for managing a project of this complexity, the Team recommends that a contractor be hired specifically for this position.

4.2. Additional Prototype

An additional prototype activity includes a 0-6 hour icing forecast at the AWC. Additional details on this are also at Appendix B.

4.3. Costs for Prototypes

Costs for managing and performing the prototypes are approximately $3.5M over the next 15 months. Specific costs for FTEs, development and fielding are identified within each plan. The NOAA Aviation Program supports some of this cost given the current funding profile and on-going funded projects.

5. Strategic Outcomes: Living the Future – How NWS Knows it has Evolved into the Future

Simply stated, we will have succeeded if:

- NWS provides consistent, relevant, more accurate forecasts that will rebuild the trust and confidence with FAA/NAS users.

- NWS is the provider of weather information for NGATS…our "stuff" will be integrated into user decision making.

- NWS staff are dedicated to aviation as a core mission

- NWS staff believes we can implement change for significant improvements.

- NWS meets FAA demand to reduce by 20% the number of meteorologists currently supporting the CWSUs. There is potential for additional FTE savings for the NWS. The prototypes will help provide insights toward answering this potential.

- NOAA assumes leadership for Aviation weather R&D&T within the Federal Government.

Appendix A

Current Aviation Operations:
Systems currently in service for production of aviation weather products include the Advanced Weather Interactive Processing System (AWIPS), the Advanced Weather Interactive Processing System for National Centers (N-AWIPS), the Weather and Radar Processor (WARP), the Aeronautical Information System Replacement (AISR), and separate, dedicated systems. The system, on which a NWS aviation weather product is produced, depends primarily on the organizational affiliation of the issuing office and unique requirements at each location. Each production system has its own characteristics, infrastructure, development organization, support provisions, and system management.

Aviation Weather Center (AWC)
AWC is one of the eight NWS National Centers for Environmental Prediction (NCEP). NAWIPS is the primary NCEP forecaster production system, used to generate most of NCEP's graphical, gridded, and text products that require forecaster interaction. AWC also uses stand-alone systems to produce fully automated supplemental aviation products such as Current Icing Potential (CIP), Forecast Icing Potential (FIP), Graphical Turbulence Guidance (GTG), and National Convective Weather Forecast (NCWD/F). Along with being an NCEP Center for the CONUS, the AWC also doubles as a Meteorological Watch Office (MWO) for the International Civil Aviation Organization (ICAO) and they provide a suite of Mid and High Level SIGWX forecast products for the World Area Forecast Center (WAFC) in Washington, D.C.

Alaska Aviation Weather Unit (AAWU)
The AAWU utilizes a combination of systems to generate products. The NMAP component of NAWIPS is used to produce the graphical products, and AWIPS is used for the remainder of the products issued by the AAWU. The AAWU also utilizes the High Resolution Image Processing System (HIPS) for satellite data interpretation, and a standalone PC for the Volcanic Ash Coordination Tool (VACT), which is used for live volcanic ash coordination between the AAWU, Anchorage CWSU and the Alaska Volcano Observatory via the Internet. The AAWU is also a MWO.

Weather Forecast Offices (WFOs)
AWIPS is the primary operational system at each WFO, and is configured for geographical coverage consistent with each WFO's area of responsibility. The Honolulu WFO is also a MWO.

Center Weather Service Units (CWSUs)
NWS meteorologists at the CWSUs compose aviation weather products using the Weather and Radar Processor (WARP) and the Aeronautical Information System

Replacement (AISR), both of which are provided and supported by the FAA. An AWIPS Remote Display (ARD) is also installed at each CWSU, which allows CWSU meteorologists to access and view AWIPS data and products through a dedicated connection to the supporting WFO. The ARD is funded by the FAA, and software maintenance is provided by the NWS.

Current Product Characteristics

- NWS aviation weather products are primarily text-based. Only a few aviation weather products originate as graphics.
- The time-resolution of some products is low, consisting of large, imprecise forecasts over large periods of time known as time smears.
- Product formats and content, and the effort to produce them, are consistent from airport to airport (e.g. a terminal aviation forecast issued for JFK looks the same and takes as much effort as one prepared for Dodge City, Kansas.)
- Product content does not specifically serve air traffic control decision points. Air traffic controllers and airline dispatchers are left to apply/interpret the forecast to their air traffic problem.
- Most aviation weather graphics are derived from text products. Decoders specific to each product must be developed to turn unique textual information into a graphic (e.g., a SIGMET decoder must be created to graphically display SIGMETs, an AIRMET decoder must be created to graphically display AIRMETs, a Convective SIGMET decoder must be created to graphically display Convective SIGMETs.)
- Some aviation text products today are so complicated they cannot be displayed graphically (e.g., area forecasts), or contain non-standard formats which make them difficult to verify (e.g., center weather advisories).
- Current products do not provide the necessary detailed, high intensity support to air traffic managers at Air Route Traffic Control Centers
- The variety of weather products can complicate decisions regarding aviation planning and traffic flow. There are numerous products that contain information on convection alone:
    - Convective SIGMETs and Outlook
    - Collaborative Convective Forecast Product (CCFP)
    - Severe Thunderstorm and Tornado Warnings
    - National Convective Weather Diagnostic and Forecast (NCWD, NCWF)
    - Corridor Integrated Weather System (CIWS)
    - Severe Thunderstorm and Tornado Watches
    - Convective Outlooks
    - Terminal Aerodrome Forecast (TAF)
    - Transcribed Weather Broadcast (TWEB)
    - Area Forecasts
    - Center Weather Advisories (CWA)
    - Meteorological Impact Statement (MIS)
    - CWSU originated thunderstorm forecast for ARTCC
    - Airport Weather Warnings

  - Tropical Storm Advisories
  - Tropical Storm SIGMETs
  - Low level significant weather prognostic graphic
  - High level significant weather prognostic graphic
- A variety of weather products may contain conflicting forecasts: Convective SIGMETs and NCWF; NCWF and TAFs; CCFP and TAFs; TAFs and CWSU verbal advice to local Traffic Management Unit.
- There are two types of weather products as defined by the FAA: Primary and Supplementary

  1. Primary Weather Product. An aviation weather product that meets all the regulatory requirements and safety needs for use in making flight related, aviation weather decisions. Examples include SIGMET and Area Forecast.

- **2. Supplementary Weather Product**. An aviation weather product that may be used for enhanced situational awareness. If utilized, a supplementary weather product must only be used in conjunction with one or more primary weather products. In addition, the FAA may further restrict the use of supplementary aviation weather products through limitations described in the product label. Examples include NCWF, CIP, FIP, and GTG.

Current Production of Graphical Forecast Products

A limited number of NWS aviation weather products are currently viewable as computer graphics. These products originate from NWS automated or manually produced computer "objects," which are then converted into both

- Hard graphics for Internet display or fax
- Coded files (BUFR, GRIB, ASCII) for NWSTG and NOAAPORT dissemination, from which users create graphic displays or hard copies

Example graphic products include

From automated objects

- GTG
- NCWF
- FIP

From manually produced objects

- Significant Weather High (SWH) for globe
- Significant Weather Medium (SWM) for portions of North America, the North Atlantic, and Europe
- 12/24 Hour Significant Weather Forecasts for CONUS
- Collaborative Convective Forecast Product

NWS Aviation Products	Product Production System	Issuing NWS Office
• Airman's Meteorological Information (AIRMET) • Significant Meteorological Information (SIGMET) for CONUS, (including Convective SIGMET) • International SIGMET (including convective and volcanic ash) for assigned Meteorological Watch Office (MWO) areas • Area Forecasts (FA) (CONUS, Gulf of Mexico, Caribbean) • Collaborative Convective Forecast Product (CCFP) • Global High and Medium Level Significant Weather (SIGWX) • CONUS Low Level SIGWX	NAWIPS	Aviation Weather Center
• Graphical Turbulence Guidance (GTG) • Forecast Icing Potential (FIP) • Current Icing Potential (CIP) • National Convective Weather Diagnostic and Forecast (NCWD/F)	Dedicated systems, configured and managed by NCEP	
• Airman's Meteorological Information (AIRMET) • Significant Meteorological Information (SIGMET), including convection and volcanic ash) for assigned WMO area • Area Forecasts (FA) and graphical products derived from FA (not updated until next FA issued) • Volcanic Ash Advisory (FV) • Graphic Area Forecast • Significant Weather Forecast Graphics	NAWIPS for graphics, AWIPS for all others	Alaska Aviation Weather Unit (for the airspace over Alaska and adjacent coastal waters)
• Terminal Aerodrome Forecasts (TAF) • Transcribed Weather Broadcasts (TWEB) • Airport Weather Warnings (AWW)	AWIPS	Weather Forecast Offices
• TAF • SIGMET (including convection and volcanic ash) for Hawaiian Islands and assigned WMO areas. • AIRMET • Area Forecast • Wind Aloft and Temperature forecasts for areas across the Pacific • Route Forecast (ROFOR	AWIPS	Honolulu Weather Forecast Office
• Meteorological Impact Statement • Center Weather Advisories	WARP, AISR	Center Weather Service Units
• Space Weather Information (although products are not aviation-specific, they are used by the aviation community)		NCEP's Space Environment Center

Aviation Weather Information Services
The NWS has a long tradition of conveying weather information verbally to users, either face to face, or by telephone. These "services" are by nature non-standard, as they are in many respects on-demand and specific in nature. Often they are in response to requests of the meteorologist to add value to an existing NWS forecast product, as the product either does not provide enough decision making information to the user, or the user is wanting a "forecaster confidence factor" added to the text or graphic forecast product. These verbal services are performed at some WFOs

and all CWSUs. In addition, CWSUs provide a varied level of additional services at the ARTCC. Examples of these NWS Aviation Weather Information Services include:

- Scheduled and on demand briefings (part time, 16x7)
- Configuration and local enhancements to the CWSU's WARP Meteorologist Workstation.
- Meteorological training to ARTCC personnel by CWSUs
- PIREP quality control and/or entry at some ARTCCs (16x7)
- Quality control of weather information (e.g., SIGMETS, winds aloft) entered into the ARTCC's air traffic control Host computer
- Weather information to air traffic controllers in support of aircraft emergencies (16x7)
- Weather product interpretation services (16x7)
- Advice to local FAA management regarding staffing requirements
- Special event forecasts and briefings for those events which affect the volume of air traffic within the ARTCC (e.g., NASCAR races, Super Bowl, etc).

Associated NWS Communication Systems
The following paragraphs summarize the NWS communications networks and interfaces currently used collection and distribution of aviation weather information.

Primary NWS Communications Networks
The NWS currently supports two primary operational communications networks (not including the "NWSNET," used principally for internal and administrative messages) for collection and distribution of weather information.

The AWIPS Communications Network (ACN)
The ACN includes both the AWIPS Wide Area Network (WAN), and the Satellite Broadcast Network (SBN), or NOAAPORT.

- The WAN is a terrestrial frame-relay configuration interconnecting all NWS Weather Forecast Offices (WFOs), River Forecast Centers (RFCs), National Centers, and Regional Headquarters (RHq). The primary hub of the WAN is the Network Control Facility (NCF), located in Silver Spring, MD. The WAN carries all data, observations, and products from all WFOs and RFCs, and is the primary path for alphanumeric products from the Aviation Weather Center (AWC). Information received by the NCF from the WAN can be forwarded to the SBN and the NWSTG, as well as to other NWS dissemination circuits.
- The SBN, or NOAAPORT, provides a one-way broadcast communication of NOAA environmental data and information to NWS offices and external users. "Uplink servers" located in the AWIPS NCF drive the NOAAPORT uplink. Each NWS WFO, RFC, RHq, and National Center receives the NOAAPORT broadcast. In addition to distributing weather information among NWS offices, NOAAPORT provides an effective means of disseminating this information to external users. Sufficient documentation is available to allow an external user to construct a NOAAPORT receiver, and a "turn key" system can be obtained from numerous commercial providers.

The National Centers for Environmental Prediction (NCEP) Network

The NCEP network is a terrestrial configuration interconnecting the geographically distributed National Centers. The NCEP network connects to the NWSTG, from which NCEP products can be forwarded to the AWIPS NCF for NOAAPORT broadcast. Due to the bandwidth limitations of the AWIPS WAN, the AWC uses the NCEP network for high-volume products such as the CIP, FIP, NCWF and GTG.

Local Dissemination Interfaces

In addition to sending and receiving weather information on the AWIPS ACN, NWS field offices support numerous local interfaces to collect observations and disseminate products. For aviation weather information, selected WFOs support a connection to systems such as the Systems Atlanta Information Display System (SAIDS, also known as IDS4). IDS4 is installed at most Airport Traffic Control Towers, Terminal Radar Approach Control Facilities, Air Route Traffic Control Centers, and Flight Service Station facilities. In general, connections for systems such as IDS4 are established at the supporting WFO nearest the associated FAA facility.

As AWIPS replaced the previous NWS operational system in the late 1990’s, the NWS and FAA established a “workstation-to-workstation” connection between each CWSU and its supporting WFO. An “AWIPS Remote Display” (ARD) was installed in the CWSU, and driven by an AWIPS workstation in the WFO. In effect, the WFO AWIPS local area network (LAN) was virtually extended to the ARD, using a terrestrial telephone connection between the two offices. The bandwidth of this T1 connection is very limited when compared to typical LAN speeds, and ARD retrieval of large products suffers accordingly.

Web Interfaces

NWS weather information is available from numerous Internet sources. The NWS supports Internet Web sites for essentially all of its operational and administrative offices. NWS aviation weather products are readily available from web servers located at the AWC. **The Aviation Digital Data Service (ADDS)** displays text, digital and graphical forecasts, analyses, and observations of aviation-related weather variables. ADDS is a joint effort of NCAR Research Applications Program, NOAA Forecast Systems Laboratory, and the Aviation Weather Center. The FAA funds and directs the continuing development of ADDS, as well as other experimental products being developed by the FAA Weather Research Program. ADDS makes access to National Weather Service aviation observations and forecasts easy by integrating this information in one location, and by providing visualization tools to assist the application of this information for flight planning. The following information is available on ADDS (http://adds.aviationweather.noaa.gov/):

- Winds, temperatures, and streamlines aloft
- Pilot Reports

- SIGMETs and AIRMETs
- TAFS
- METARS
- Radar
- Satellite
- Current Icing Potential (CIP) and Forecast Icing Potential (FIP)
- National Convective Weather Forecast (NCWF)
- Graphical Turbulence Guidance (GTG)
- Surface Weather Prognostic Charts

ADDS provides these products and tools to the aviation community through the Internet, using standard Internet protocols, formats, and platform-independent applications (e.g., HTTP, GIF, JPEG, JAVA). A server located at the Aviation Weather Center currently hosts ADDS products and JAVA visualization tools. All products on ADDS are available on the NWSTG in text, GRIB and/or BUFR file formats.

Accuracy: The NWS has verified TAFs for decades. The NWS began verification of other aviation forecasts in the late 1990s. Performance measures for aviation forecasts include icing, turbulence, low ceiling and visibility, and convection forecasts. Performance measures for forecast accuracy are generally Probability of Detection (POD) and False Alarm Ratio (FAR). Current NWS forecast performance for icing, turbulence, convection, and low ceiling and visibility forecasts are far below FAA stated needs[1].

Research, Development and Transition: The FAA's Weather Research Program provides the bulk of applied weather research for aviation. Since 2001, the FAA and the NWS have developed a formal Aviation Weather Technology Transition (AWTT) process to smoothly transition new capabilities being developed by the FAA's various Product Development Teams into NWS operations. This process continues to improve to meet it's objective. However, for the past decade, the FAA's focus has been to totally automate these products with the objective to have these available for operational use by end-user operators (pilots, dispatchers, controllers, etc.) As the majority of these products have gone through the AWTT process they have met various roadblocks towards becoming operational as a primary product for the end-user and they have instead been designated "supplemental" to the NWS primary products. One change that must be made in this process is to look at how these products can be incorporated into the NWS forecast process to develop a National Digital Database of aviation elements. This then would become the primary product from which legacy text and other aviation products are generated.

[1] "FAA Weather Information Needs," September, 2000.

APPENDIX B: Prototypes:

ATWO Activity 1 – Improved Terminal Forecasts

Objective – Test the ability of the NWS to improve the accuracy, consistency, and timeliness of terminal aerodrome forecasts (TAFs). Secondly, facilitate meeting a key strategic goal of the Next Generation Aviation Traffic System (NGATS): obtaining common situational awareness across all National Airspace System (NAS) operators and users.

What will be done:

1. Build and test prototype of an ATWO TAF production process. This prototype essentially test the following:
   a. Ability of a forecaster with a single focus on aviation weather, comprehensive training, and advanced AVNFPS software to improve terminal forecasts. This includes the following forecaster attributes:
   - Ability to learn and apply local weather effects including the general climatology to the production of a TAF for a distant terminal facility.
   - Apply local airport specific terminal amendment criteria (ASTAC) into the production of terminal weather forecasts.
   - Effectively manage forecasts at many terminal facilities simultaneously.
   - Produce TAFs at higher issuance rates (i.e. 1, 2, or 3 hourly), in an event driven environment, or a combination of both.
   - Apply information on current air-traffic flows, traffic congestion and dispatch operations to help an aviation forecaster apply his/her time most effectively (i.e. most enhance safety and efficiency of NAS).

   b. Ability to improve consistency of products and services through integration of the TAF forecast process with other ATWO functions:
      - The production of terminal and TRACON graphical decision aids
      - Briefings with FAA partners and NAS users
      - 0-2 hour forecasts of convection, icing, turbulence; associated SIGMETS, and the Convective Collaboration Forecast Process (CCFP).

2. Conduct an alternate test of improving TAF production at WFOs:
   a. Ability of a forecaster who is cross program utilized to improve terminal forecasts given:
      - Enhanced AVNFPS that facilitates application of ASTAC, incorporation of local climatology or effects, and the production of event driven or hourly TAFs.
      - Improved aviation training program.
      - A higher priority (by management) placed on TAF.
      - An improved collaboration process between WFO, ATWO (without TAF production), and AWC.

Required Infrastructure

Equipment: The experiment will require several AWIPS workstations for the ATWO prototypes. Assume two workstations per prototype site.

Software: (to be developed by OAR/GS and NWS/OST)

- Add functionality to AVNFPS 3.1 to fully format and recommend proactive amendments for many terminals. The enhanced functionality would incorporate ASTAC and be based on the integration of numerous inputs. Such data sources might include: conditional climatology, 5-minute ASOS observations, model output statistics, point NWP model soundings, NCWF-2, and the Aviation Weather Research Program's (AWRP) ceiling / visibility grids. Integration of the data into an AVNFPS database would be done via use of fuzzy logic or other similar method.
- Incorporation of air-traffic information into AWIPS displays.
- Fx-Connect software to collaborate with other ATWOs, AWC, or WFOs with respect to high impact weather events.

Training: Participating forecasters will need to have completed the following aviation training: Impacts of Weather on Air-Traffic Management, Distance Learning Aviation Course, Distance Learning Aviation Course II (as available), NWSTC icing / turbulence modules, and the core Advanced Warning Operations Course. Training in use of new software and technology will be provided during the prototypes.

Dependencies

1. Each experiment must be carried out over a sufficient enough time and at enough locations to sufficiently sample a variety of significant weather events.
2. Facilitation through automation: AVNFPS or other software must be developed to provide acceptable "first-guess" routine terminal forecasts. Secondly, it must also aid in the proactive production of "first-guess" terminal forecast amendments.
3. AWIPS SCAN like functionality based on both live radar inputs and short-term forecasts such as NCWF II that would support aviation forecaster ability to proactively amend several terminal forecasts quickly.
4. Process must be compatible with other prototyping efforts (i.e. production of TDAs and remote briefing capability with FAA ATC units.
5. Consistent, reliable, and accurate Terminal TDA is dependent on the success of this effort.
6. 5 Minute ASOS Observations.
7. Radar Mosaics (Base Reflectivity Echo Tops)
8. AWIPS Attributes for ATC Map backgrounds.
9. Experienced forecast personnel.

How it will be done

<u>Location:</u> The ATWO prototyping activities will be conducted at the Dallas/Ft. Worth CWSU and at up to two other locations. The alternate prototype will be conducted at up to four WFOs.

<u>Methodology:</u> Determine the best forecast process in terms of its ability to efficiently produce accurate, consistent, and timely TAFs. Secondly, which process facilitates the greatest consistency and common situational awareness across NWS aviation services in general. This can be done in part by comparing the production of TAFs in the setting of an ATWO prototype to the traditional WFO setting. Forecasters in both tests will receive similar training and equipment. Further, results from the test will be compared to current TAF production. That is the status quo including the current forecaster proficiency and equipment. In terms of the ATWO prototype, the test will specifically evaluate the following:

The ATWO and alternate WFO tests will be done in the blind. To the extent possible, WFO forecasters will not know which of their terminal forecasts are being prototyped and the prototype operations will not have access to the official or WFO TAFs. The NWS will seek both operators and users of the NAS to evaluate the services of both the ATWO and alternate prototypes. Evaluators will have access to both the official and prototyped TAFs. In the case of the alternate prototype where the official TAFs have been enhanced, evaluators will not be told which WFO TAFs are part of the alternate prototype.

The alternate prototype, that of improved TAF production at the WFO, should be done in the context of cultural change the ATWO implies. The NWS modernization of the late 1990's was based significantly on the idea of a cross trained and distributed workforce. While the ATWO maintains a distributed production process, it also asserts that in the case of aviation a significant degree of specialization is needed to attain desired performance levels. The alternate prototype tests this assumption by providing WFO with all improved training and technology enhancements of ATWO test. The WFO will need to match performance of ATWO prototype without degradation in performance of any other WFO program.

It is not expected that a fully enhanced AVNFPS as described above will be fully available for all four demonstration periods. Rather the functionality will be come incrementally available. The idea is to follow a test-bed approach where it is expected that developers will have opportunity to observe and interact with forecasters as they prepare TAFs in order to perfect and prioritize needed functional enhancements to AVNFPS.

Both the NWS and NGATS see future terminal forecasts produced with a 4-D gridded database. There are however differences of opinion on how such a database would be populated and how a meteorologist would interact in population of a complex and rapidly refreshed database. In terms of this prototype, the ability of the enhanced AVNFPS to integrate many different datasets into a database from which to build terminal forecast, tactical decision aids, etc. represents a first step towards a 4-D database. It is envisioned that such a databases could also be influenced via user edits made to work TAFs in the AVNFPS edit GUI.

Participants: In addition to the participants mentioned above, NWS OST, OAR/GSD, and NWS OCWWS Aviation Services Branch will be involved in providing infrastructure, software development/support as well as various evaluation and assessment activities.

Assumptions: the TWEB will not be an NWS product by 2008, to be replaced by the elements of the Graphical Forecast for Aviation (GFA)…and therefore will not be tested during this prototype activity.

Projected Milestones:

Feb – Mar 2006: Prior to first prototype period, develop initial AVNFPS upgrades, deploy AWIPS workstations, and select participants.

Oct – Dec 2006: Prior to third prototype period, evaluate forecaster, NAS operator & user feedback. Refine and retest software functionality. Assess and update training requirements.

Costs: 4 NWS FTEs for ATWO prototypes, $100K for AWIPS workstations, 1.5 FTEs, $300K for software development.

ATWO Activity 2 – Improved Collaboration

Objective – Test and evaluate capability that will enable NWS to collaborate in real-time between the ATWO, aviation centers (e.g. AWC, AAWU)) and WFO(s) to ensure consistency, relevancy and high-quality forecasts.

What has to be done:

New or updated FX-Connect (FXC) server(s) must be installed at OAR/GSD, and FXC clients must be installed at the prototype locations. This will provide an adequate system infrastructure and communications backbone.

Implicit in the production of decision aids is a strong collaborative process between the NWS offices. The AWC/AAWU and NWS meteorologists must communicate on a regularly-scheduled or event-driven basis to ensure that a seamless and consistent suite of TRACON and Terminal products and services are routinely provided. It is also recognized that critical weather, such as convection, would necessitate clear and concise communication.

Technology is a fundamental constituent in the collaborative forecast process identified above. In the near term, GSD is continuing development of the FXC visual collaboration software that will allow meteorologists to interactively conference while sharing object-oriented and geo-referenced graphics. Eventually, collaboration will be facilitated through the shared responsibility of maintaining a national digital forecast database containing aviation elements.

Required Infrastructure

For this prototype activity, the FXC software must be available to all participants or customers involved in the collaboration process. There should be no additional computer and communications infrastructure needed for this prototyping since it is directly linked to the capability installed for the Terminal and TRACON TDAs. Figure 1 below depicts the system infrastructure and data flow required for the Improved Collaboration.

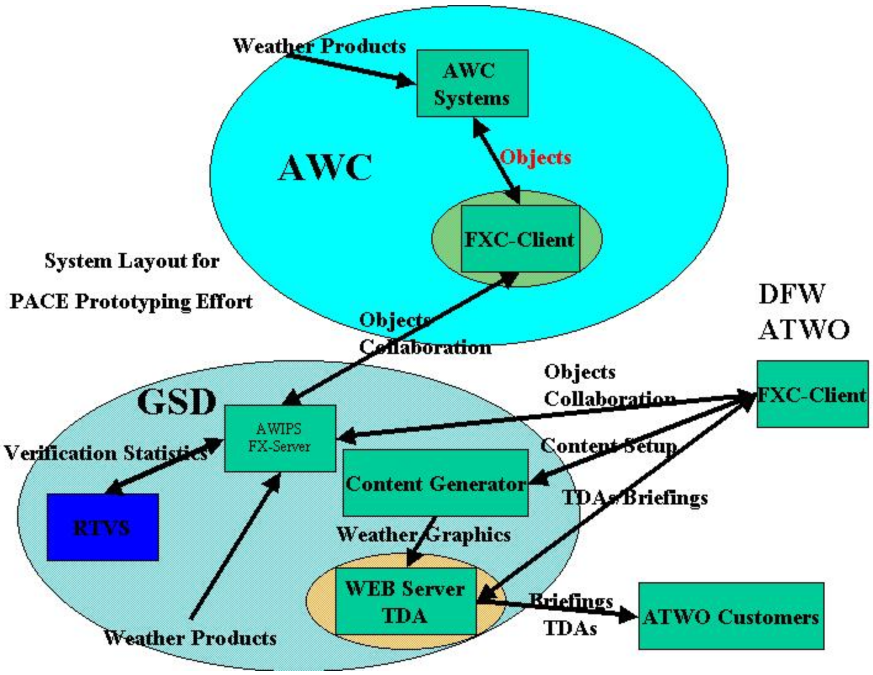

Figure 1

Dependencies

Additional training will be required for forecasters, customers at all prototype locations.

How it will be done:

Participants: In addition to the participants mentioned above, NWS OST, OAR/GSD, and NWS OCWWS Aviation Services Branch will be involved in providing infrastructure, software development/support as well as various evaluation and assessment activities.

Assumptions: Personnel availability, IT and computer system interfaces in place reducing infrastructure obstacles.

Training: GSD will develop a training package for operators and customers for use of the collaboration software. The Prototype Training Team will develop additional training materials as needed.

Verify: Product delivery and user satisfaction.

Costs:

Equipment Cost: (No additional after TDAs are developed)

FTEs:

Infrastructure Setup:	.167	FTE	40K (No additional after TDAs are developed)
Briefing Design/Implementation/Testing:	1.5	FTE	300K
Training/Documentation	.25	FTE	60K
Management	.25	FTE	70K

Travel :

Infrastructure Setup:	7K	(No additional after TDAs are developed)
Training/Demonstrations/Evaluations:	15K	

ATWO Activity 3 – Production of Terminal/TRACON Decision Aids

Objective –Test and evaluate a capability enabling NWS to develop real-time consistent, relevant Traffic Flow Management Decision Aids for use by NAS operators in the Terminal and Terminal Radar Approach Control (TRACON) environments.

What will be done:

New or updated FXC server(s) must be installed at OAR/GSD, and FXC clients must be installed at the prototype locations. This will provide an adequate system infrastructure and communications backbone.

The NWS will produce terminal decision aids for pacing airports (pacing airports are those recognized as having the largest impact on NAS capacity and operations) figure 1 depicts CONUS pacing airports. The terminal decision aids will be valid for six hours and based directly on AVNFPS developed TAFs. Figure 2 depicts the Dallas/Fort Worth (DFW) TRACON area, generally this area is approximately 40 nautical miles from the center of the DFW airport terminal and extends vertically to about 12,000 feet. Figure 3 depicts an example of a terminal decision aids for convective hazards.

Figure 1

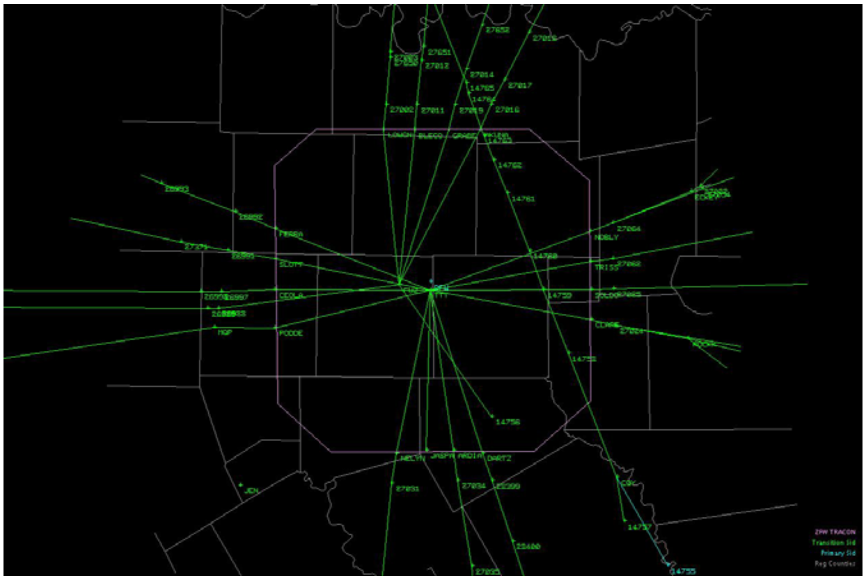

Figure 2

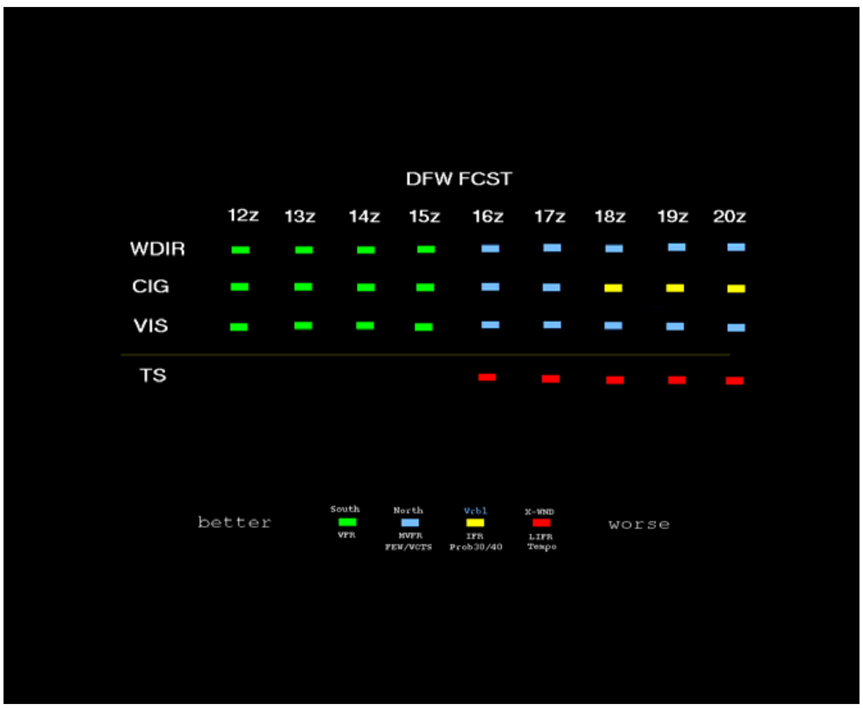

Figure 3

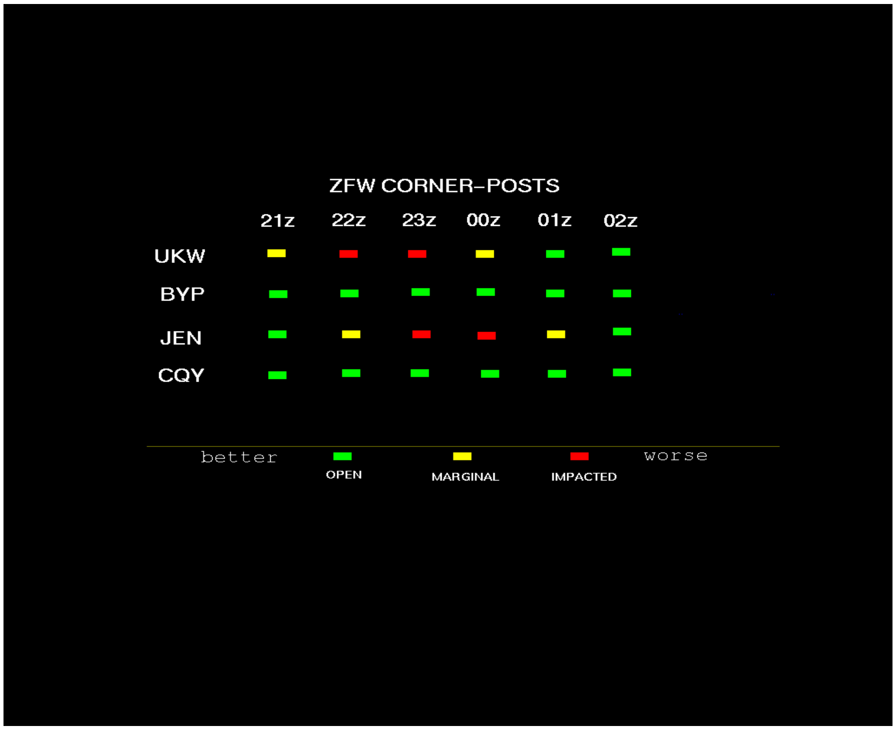

Figure 4

The dependence of the decision aids on an AVNFPS-generated TAF requires that NWS meteorologists issue timely and accurate TAFs. These terminal-based and TRACON decision aids will allow the NAS operators quick access to information needed to manage capacity and flow sequencing. It is envisioned that the terminal-based decision aids will require frequent issuances (hourly) and updates every 15 to 30 minutes, depending upon air traffic demands in and around the pacing airport. Figure 4 depicts an example decision aids for TRACON decision-making based on the impact of thunderstorms.

It is envisioned that AutoNowcaster (ANC) and NCWF2 will provide input for convective fields that will be ingested by AVNFPS. AVNFPS TAF is passed to the content generator for creation of the Terminal decision aid at the same time the program issues an updated TDA for NAS decision makers. By using this approach there will be a consistent flow of information from the initial convective products supplied by ANC and NCWF2 providing throughput for the TAF and TDAs. The relevancy of the new NWS supplied products will come in the form of the TDA that will be updated continuously for the NAS customers.

Required Infrastructure

Decision Aid products are needed in formats requiring little or no interpretation by NAS customers. To produce these decision aids during the prototype period, it is envisioned that ANC, AWIPS, AVNFPS, and FXC will all be required tools for ATWO meteorologists. Figure 5 depicts the flow of data and system architecture infrastructure required to produce the Terminal and TRACON TDAs.

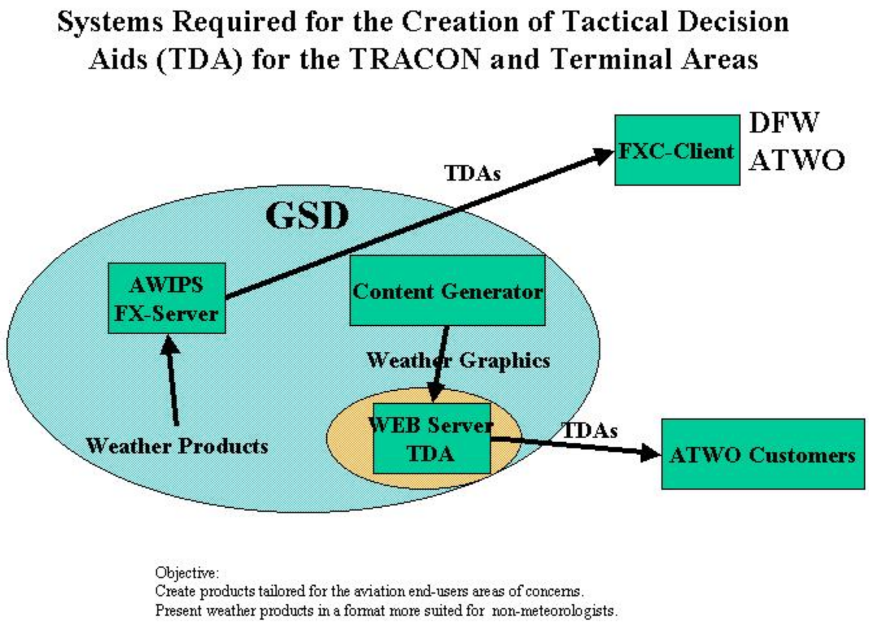

Figure 5

Dependencies

This work is dependent upon funding for GSD and OST developers and modifications to the display applications and production systems. FAA and industry customers (i.e., Southwest Airlines, American Airlines, NBAA) will evaluate product content consistency, relevance and accuracy for NAS operations.

<u>Training:</u> GSD will develop a training package for operators and customers for use of the Terminal and TRACON Decision Aids. The Prototype Training Team will develop additional training materials as needed.

How it will be done:

<u>Participants:</u> In addition to the participants mentioned above, NWS OST, OAR/GSD, and NWS OCWWS Aviation Services Branch will be involved in providing infrastructure, software development/support as well as various evaluation and assessment activities.

Costs:

Equipment Cost:

FXC/AWIPS:	160K
RTVS:Impact Assessment	5K
Communication Hardware/Setup:	10K
Communication Annual Charges:	40K for the test Period. 30K recurring/annually

FTEs:

Infrastructure Setup:	.167	FTE	40K
AvnFPS Integration:	.0834	FTE	20K
Terminal/TRACON TDA Development:	1.5	FTE	300K
Training/Documentation	.25	FTE	60K
Management	.25	FTE	70K
Impact Assessment	1.25	FTE	250K

Travel :

Infrastructure Setup:	7K
Training/Demonstrations/Evaluations:	15K
Impact Assessment	4K

ATWO Activity 4 – Development of Remote Briefings

Objective – Test and evaluate a capability that will enable NWS to produce and deliver to customers in real-time or "on-demand" remote weather briefings that are consistent and relevant to Air Traffic Operations.

What has to be done:

Design a Web Portal that will allow National Air Space customers to interact with NWS developed Remote Briefing capability.

1. Define products required for a remote briefing
2. Define the capability of "on-demand," "customer pulled" or "self brief" functionality of the Remote Briefing.
3. Define functional ability for "Customer-Meteorologist" interactive briefing.
4. Develop and conduct training operational forecasters and customers.
5. Evaluate workload.
6. Prepare report and recommendations.

If successful, develop budget to proceed with "path to operations" and schedule support from JPDO/FAA/NOAA sources.

Technology is a fundamental component in the remote briefing process identified above. Installation of new or updated FXC server(s) at GSD and clients at the prototype locations must be accomplished for successful prototyping. This will provide an adequate system infrastructure and communications backbone. In the near term, GSD is continuing development of the FXC visual collaboration software that will allow forecasters to develop and post remote weather briefings to a web portal. Through this web portal FAA or other aviation customers will be able to access Air traffic relevant weather briefings.

Required Infrastructure

The required technology should not incur additional costs being directly linked to the infrastructure described in the Terminal/TRACON TDAs. Figure 1 below depicts the system infrastructure and data flow required for the Remote Briefings.

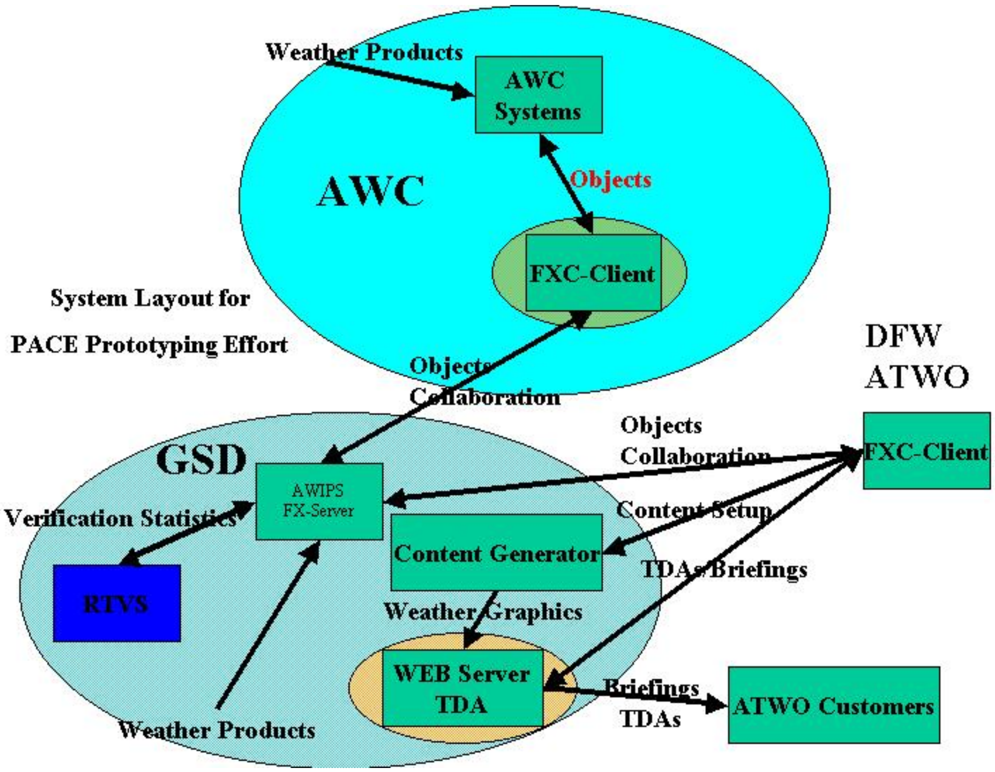

Figure 1

Dependencies

This work is dependent upon funding for OAR/GSD and OST developers and modifications to the displays applications, and production systems. FAA and industry customers (i.e., Southwest Airlines, American Airlines, NBAA) will evaluate product content consistency, relevance, and accuracy for NAS operations.

How it has to be done:

<u>Participants</u>: In addition to the participants mentioned above, NWS OST, OAR/GSD, and NWS OCWWS Aviation Services Branch will be involved in providing infrastructure, software development/support as well as various evaluation and assessment activities. Other industry partners (e.g., Southwest Airlines, American Airlines, and NBAA) will assist in evaluation activities.

<u>Training:</u> GSD will develop a training package for operators and customers for use of the Remote Briefing Software. The Prototype Training Team will develop additional training materials as needed.

Verify: Product delivery and content are consistent and meets customer satisfaction.

Costs:
Equipment Cost: (There are no additional costs after TDAs are developed)

FTEs:

Infrastructure Setup:	.167	FTE	40K (No additional after TDAs are developed)
Briefing Design/Implementation/Testing:	1.5	FTE	300K
Training/Documentation	.25	FTE	60K
Management	.25	FTE	70K

Travel :

Infrastructure Setup:	7K	(Only required if TDAs are Not implemented)
Training/Demonstrations/Evaluations:	15K	

ATWO Activity 5 – Improved 0-2 Hour Convective Forecasts

Objective – Improve consistency, relevancy, and quality of 0-2 hour convective forecast products: Terminal Aviation Forecasts, Tactical and Terminal Decision Aids, Airport Weather Warnings, digital Convective SIGMETs and the National Convective Weather Forecast Product (NCWF-2).

What has to be done – Merge existing, multiple and inconsistent convective products and determine the role of the forecaster in nowcasting to improve initialization and monitoring for semi-automated convective digital products.

Implement NCAR's AutoNowcaster (ANC) for convection; connect ANC output to NCWF-2 input; connect NCWF2 output to support Convective SIGMET inputs, plus Terminal Aviation Forecasts (TAF), and connect TAF output to Terminal Decision Aids.

1. Define “Meteorologist in/over the Loop” (MITL) procedures and document best practices;
2. Measure value (+/-) of forecaster input versus no input;
3. Develop and conduct training for operational forecasters;
4. Evaluate forecaster workload;
5. Prepare report and recommendations; and
6. If successful, develop budget and schedule to support FAA/NOAA enterprise.

Required Infrastructure

MITL-ANC interface software will be developed at NCAR to support NCWF-2. NCWF-2 output will provide the primary convective guidance for digital Convective SIGMET, TRACON Tactical Decision Aids, and TAFs. NCEP/AWC will develop and test the digital Convective SIGMET software.

This structure is compatible with other 0-2 hour convective forecast prototyping activities (TRACON and Terminal Decision Aids, TAFs).

Dependencies

- Each experiment must be carried out over a sufficient enough time and at enough locations to sufficiently sample a variety of significant weather events.
- Process must be compatible with other prototyping efforts (i.e. production of TDAs and remote briefing capability with FAA ATC units).
- Requires trained, (dedicated) convective forecasters during demonstration periods.

How it will be done?

Methodology – Convection

The proposed activities leverage nowcast demonstrations of the Auto-nowcaster system that runs in the Dallas/Ft.Worth WFO and in the Illinois/Indiana area and the National Convective Weather Forecast (NCWF) aviation forecast system. The objective of the proposed work is to blend these systems and to demonstrate the role of the forecaster in improving automated gridded thunderstorm nowcast products for aviation users.

The demonstrations in these regions will be staged such that the current MITL demonstration at the Ft. Worth WFO is not impacted. At the Ft. Worth WFO, MITL data will be displayed on the Internet for the CWSU in early spring. In the meantime, we will work towards developing and implemented a blended ANC/NCWF system that runs in the Illinois/Indiana region starting in June 2006. Based on the success and lessons learned from the Illinois/Indiana installation, the new blended system will be installed in Ft. Worth in the fall of 2006.

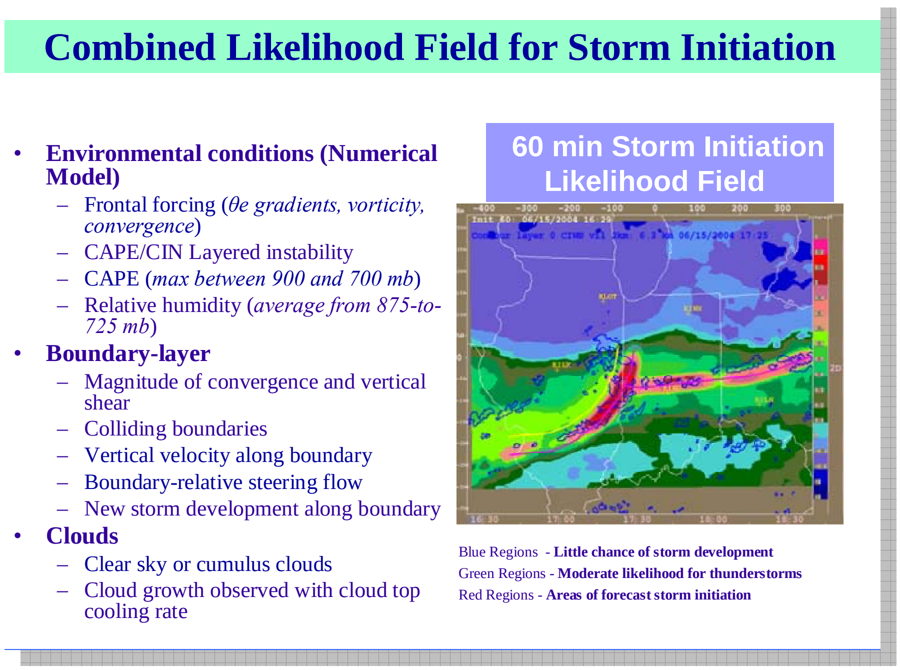

Figure A: ANC Likelihood Field

Participants: In addition to the participants mentioned above, additional NWS aviation forecasters may be needed to assist during demonstration periods.

Projected Milestones:

Winter ’06
- Design mock-ups of MITL-ANC display for discussions with ATWO and WFO forecasters.
- January – February 2006, initial testing of connectivity.
- Based on input, implement and test display at the Ft.Worth WFO.
- Design blended MITL-ANC system.
- Modify software as required.
- Implement and test blended MITL-ANC system running over Illinois/Indiana domain at NCAR.
- Design verification methodology

Spring and Summer ‘06
- Install and maintain WWW display in Ft. Worth WFO.
- Install and maintain MITL-ANC convective system
- Train users on WWW display
- Train and work with forecasters on the MITL-ANC system
- NWS forecasters assists NCAR in 1) evaluating the various NWP models in the blended system running over the Illinois/Indiana domain, 2) using forecaster display tools and 3) suggesting improvements and methodologies for the blended MITL-ANC system.

Fall and Winter ‘07
- Install MITL-ANC system at Ft.Worth WFO and AWC
- Analysis and system verification

Training: Operational forecasters require training in the following areas:

- The 0-2 hour convection production process (2 hours);
- Advanced convection forecasting techniques (8 hours);
- The Auto-Nowcaster system (4 hours) with at least two shadow shifts (16 hours);
- FX-Collaborate (4 hours); and an
- Operational Checkride (1 hour).

Costs: Prototype for 15 month period.

Note: majority of funding to be provided in FY06; exception travel.

1. NCAR – ANC/NCWF-2

Staffing: 0.5 FTE engineering, 0.75 FTE science – 300K
Equipment: 3 workstations – 16K
Travel: 4K
Total - $320K

2. NCEP/AWC -- Digital Convective SIGMET GUI
Staffing: FTE .50 -- 150K
Travel: 14K
Total - $164K

3. NOAA ESRL/GSD -- Verification
Staffing: 0.8 FTE engineer, 0.6 FTE scientist = $300K
Equipment: 5K
Travel: 4K
Total – $309K

Background on the Auto-Nowcaster and NCWF systems

Thunderstorm Auto-Nowcaster

The ANC provides combined 1 hour forecasts of the storm extrapolation and evolution (deterministic) and the likelihood (probabilistic) for convection initiation every 5 min (Fig. a). The initiation forecasts are produced using a fuzzy engine which combines a set predictor fields into a single storm initiation interest field (see Fig. A). The predictors are used to characterize the large-scale environment (stability and large-scale forcing), boundary-layer structure, boundary (lines of boundary-layer convergence) characteristics, cloud type, and vertical development (as indicated by cooling IR temperatures). The probabilistic forecast of storm initiation is determined by applying a threshold to the storm initiation interest field shown in Fig. A. The storm initiation interest field was also calculated for a lead time of 2 hours to look at the potential to forecast storm initiation at longer lead times. In addition to running the ANC, a three-dimensional version of the Variational Doppler Radar Analysis System (VDRAS) and a state-of-the-art version of MM5 were run over ILL/IND FDP region. These systems provided additional high-resolution predictor fields that were looked at in real time to assess their utility for ANC.

NCWF Probabilistic Forecast Demonstration at AWC

The NCWF-2hr system is a D-3 experimental system run at the AWC and available for viewing in Experimental ADDS. The goal of NCWF-2 is to provide reliable, rapidly-updating, short-term, probabilistic forecasts of convection at high resolution to aviation interests for tactical decision-making. This product was developed to address one of the overarching issues put forth by the National Research Council on Weather Forecasting Accuracy for FAA Traffic Flow Managers has stated that there is the need for “2 – 6 –hr forecasts of convective weather [that are] probabilistic, designed for utility and value to the user; highly specific in time and space and automatically updated with low latency and high reliability.” As a preliminary step towards understanding and utilizing probabilistic forecasts, NCWF was modified to provide probabilistic information resulting in a new system called NCWF-2. The probabilities are based on the fractional coverage of the extrapolated and trended convective cells in a given area. The size of the area used to determine the fractional coverage can be varied to give an indication of the confidence in the forecast. Thus, the area or “filter” used to calculate the probabilities for a 30 min forecast is much smaller than that used for a 2 hr forecast. In practice, the size of the filter is also a function of synoptic regime and the accuracy of the forecast technique. This is illustrated in the figure where the specificity of the forecast decreases with time.

The NCWF-6hr system is a D2 test system that takes advantage of the strengths of state-of-the art extrapolation/trending and rapidly-updating numerical weather prediction (NWP) forecasts. The resulting probabilistic forecast products will be disseminated via web-based applications. Production of operational, rapidly updating

1-6 hour probabilistic forecasts of convection requires blending the NCWF probability forecast (which is primarily based on extrapolation) and the Rapid Update Cycle (RUC) Convective Probability Forecast (RCPF). Several modifications were made to the experimental D3 version of NCWF-2 which produced 0-2 hr probabilistic forecasts of convection to extend it out to 6 hours. The motion vectors, the spatial filter for generating probabilities, and the treatment of growth and dissipation had to be modified. Validation studies revealed large biases in the RCFP coverages and probabilities and also that dissipation was not well treated in either system. These issues had to be addressed prior to blending the two systems. First, a bias correction is applied to the RCFP data. Then a climatological dissipation filter is applied to the two data sets by reducing probabilities of convection in areas where climatology shows storms usually dissipate. The calibrated/dissipated probabilistic forecasts are then blended using a weighting function that takes into account the relative skill of each forecast system and is a function of lead time.

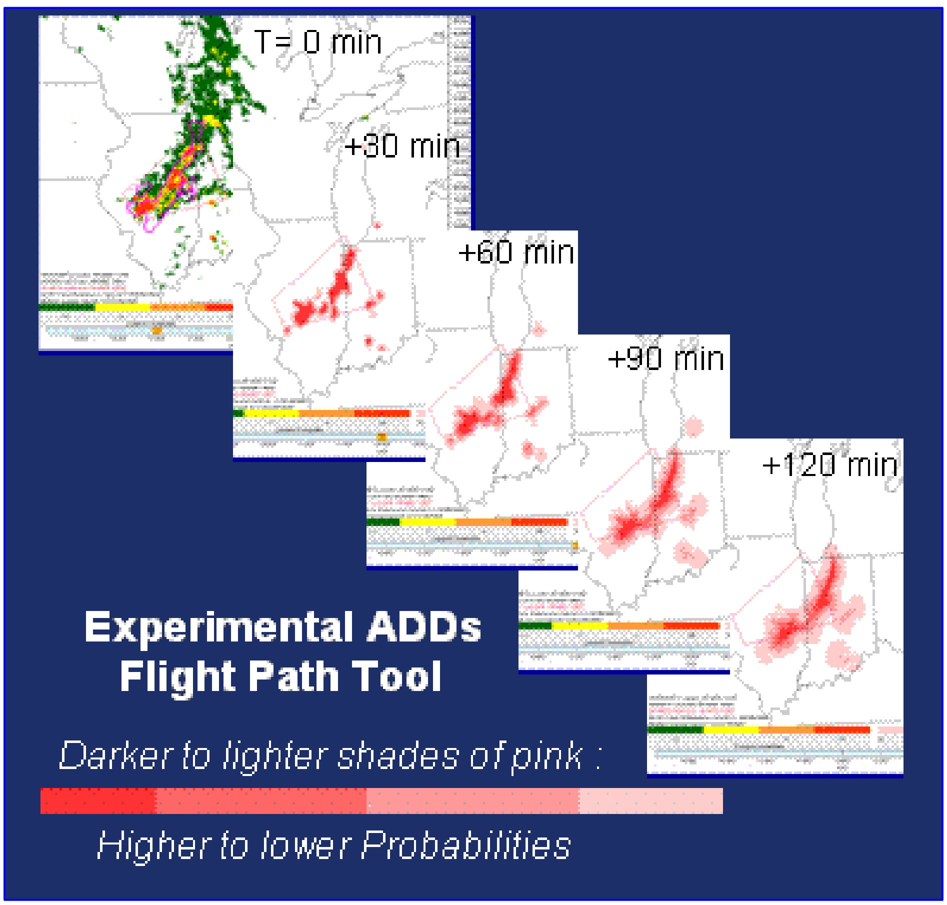

Figure B: NCWF-2

Graphical Convective SIGMET

The first step towards aviation warning process improvement is to develop and test a Convective SIGMET digital to text formatter. This tool will meet present day through

2015 product formats and provides an interface to graphical to graphical production with a higher spatial resolution and time resolution.

This prototype builds on an ongoing prototype (G-AIRMET) currently being conducted at the AWC for CONUS AIRMETs. If successful, this development will provided the foundation to support all United States Meteorological Watch Offices (MWO) – standardizing product format, production processes including collaboration; a graphical production process to support consistent, reliable, and accurate aviation advisories and warnings.

Graphical Convective SIGMET Concept:

- Digital form representing location of thunderstorms meeting Convective SIGMET criteria for a minimum of 0, 1, and 2 hours from issuance time.

- Corresponding text advisory is consistent with the digital information. Facilitates effective communication of aviation thunderstorm advisories in verbal form, plus meets current FAA and ICAO standards.

- Digital format transforms advisory/warning information into a visualization which provides an accurate representation of the convective hazardous area on all display devices used by pilots, controllers, dispatchers, and general aviation users.

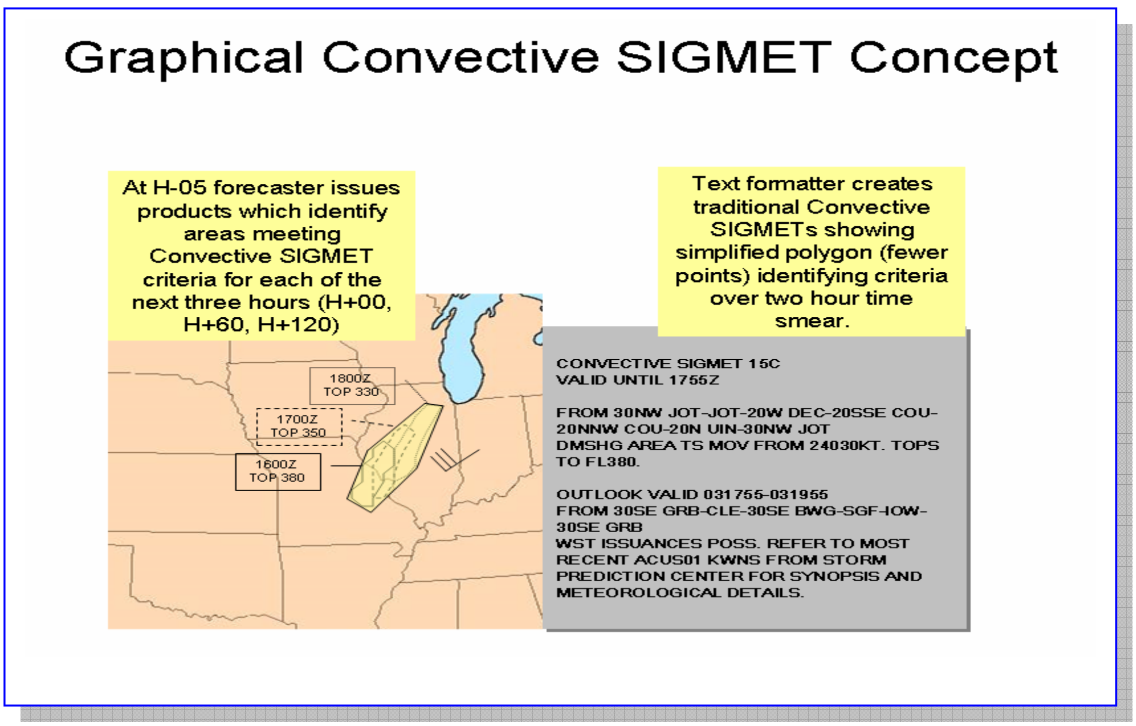

Figure C: Digital Convective SIGMET

<u>Advisory/Warning Software Functionally</u>
Develop and test advisory/warning software similar to the G-AIRMET software currently under development at NCEP for N-AWIPS. This software is comparable to NWS's WARNGEN software.

This technique allows the meteorologist to draw (outline) the start, ending, and intermediate locations of the hazard. Then the formatter software would combine these outlines and produce digital and text products.

Other Prototype Activities – Improved 0-6 hour Icing Forecasts

Objective – Improve consistency, relevancy, and quality of 0-6 hour icing forecast products: Current Icing Potential (CIP), Forecast Icing Potential (FIP), and digital icing AIRMETs/SIGMETs. Also provides guidance for related TRACON and Terminal Decision Aids.

What has to be done – Merge existing, multiple and inconsistent icing products and determine the role of the forecaster in nowcasting to provide an improved initialization for automated icing (CIP/FIP) aviation weather digital products:

1. Define "Meteorologist in the Loop -- Auto-Nowcaster" (MITL-ANC) procedures and document best practices;
2. Measure value (+/-) of forecaster input versus no input;
3. Develop and conduct training for operational forecasters;
4. Evaluate workload;
5. Prepare report and recommendations; and
6. If successful, develop budget and schedule to support FAA/NOAA enterprise.

Required Infrastructure

The MITL-ANC interface software will be developed at NCAR to support CIP/FIP.

Dependencies

- Each experiment must be carried out over a sufficient enough time and at enough locations to sufficiently sample a variety of significant weather events.
- Process must be compatible with other prototyping efforts (i.e. production of TDAs and remote briefing capability with FAA ATC units).

How it will be done

Location – CONUS domain (NCAR & AWC)

Methodology

The NCAR Research Applications Laboratory (RAL), through the FAA Aviation Weather Research Program (AWRP) InFlight Icing Product Development Teams, has developed automated current and forecast icing products (CIP & FIP). At this time, the data flow for the CIP/FIP algorithm does not include forecaster input. The value of such input is not known, nor is it well understood how the forecaster can add value to the gridded information produced by CIP/FIP.

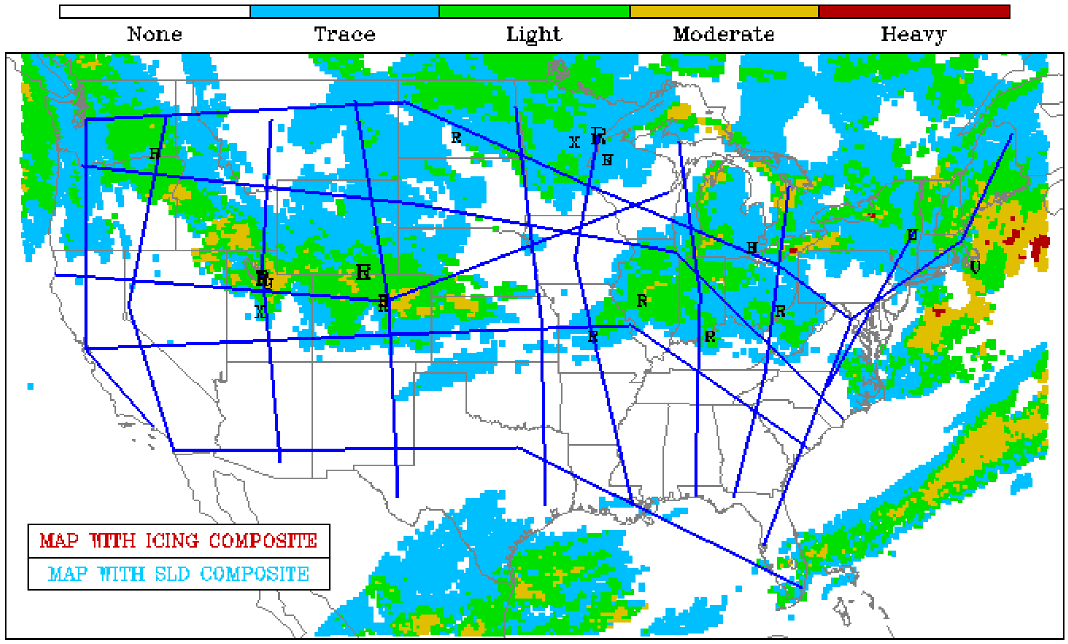

Figure A: Composite Current Icing Potential

The proposed activity builds on the MITL-ANC convective demonstration described in the "Improving 0-2 Convective Forecast". The objective of the proposed work is to develop and test an MITL-ANC system for icing that enables forecasters to alter automated CIP/FIP-produced inflight icing fields using available model outputs and observations combined with scientific knowledge and forecast experience. NCAR icing researchers will team with AWC forecasters to optimize the Auto-nowcaster for real-time icing diagnosis/forecast grid alteration.

Goals

NCAR with AWC forecaster input will develop an effective icing forecast MITL-ANC tool:

- based on manipulation of CIP/FIP inputs and intermediate algorithm steps;
- with complete data ingest and display capabilities;
- linked to verification system (such as RTVS) with immediate analysis and display capabilities; and
- ready for implementation at AWC to coincide with CIP D4+/FIP Severity products

Participants: In addition to the participants mentioned above, additional NWS aviation forecasters will be needed to assist during demonstration periods.

Duration: January - December 2006, R&D, initial testing of ANC concept with CIP/FIP; implementation & training. January - February 2007, March –April 2007 prototype demonstration period.

Projected Milestones:

Winter ’06
- Design mock-ups of MITL-ANC icing display for discussions with AWC/CWSU forecasters.
- Develop blended FIP, MITL-ANC system
- Modify software as required.
- Implement and test blended system running over CONUS domain at NCAR.
- Design verification methodology

Spring and Summer ‘06
- Test MITL-ANC icing software at NCAR
- Train and work with forecasters on the MITL-ANC system
- NWS forecasters assists NCAR in 1) evaluating the various NWP models in the blended system running over CONUS domain, 2) using forecaster display tools and 3) suggesting improvements and methodologies for the blended MITL-ANC system.

Fall ’06 and Winter ‘07
- Conduct icing demonstrations
- Analysis and system verification on FIP augmentation
- Implement using CIP

Performance Assessments: Does the advisory/warning provide consistent, reliable, and accurate weather information for the National Aerospace System?

Three specific performance assessment activities for convection evaluations that would be completed:
- Real time feedback would be provided to the forecasters during the forecast process. Feedback would be in the form of statistical trends (bias trends, forecast error trends etc) and graphics that would provide useful information for correcting future forecasts (ESRL/GSD Lead).
- An objective measure of forecast skill with and without the forecaster in the loop would be measured and the results summarized in a report. (ESRL/GSD Lead).
- Subjective feedback would be gathered from the FAA, Airline Dispatch, and GA participants as to the improvement in forecast performance and forecast usefulness and summarized in a report (NCAR lead)

Training Requirements: Operational forecasters require training in the following areas:

- The 0-6 hour icing production process (2 hours);
- Advanced icing forecasting techniques (8 hours);
- The Auto-Nowcaster system (4 hours) with at least two shadow shifts (16 hours);

- FX-Collaborate (4 hours); and an
- Operational Checkride (1 hour).

Costs: Prototype for 15 month period.

1. NCAR – MITL-ANC Icing
   Staffing: 0.70 FTE FY06, 0.55 FTE FY07
   Equipment: 2 workstations – 12K
   Travel: 4K each FY06, FY07
   Total - $210K

2. AWC – Operational testing
   Staffing: .24 (3 months) FTE Forecaster
   Equipment: workstations & software – 25K
   Travel: 10K
   Total – 35K

3. NOAA ESRL/GSD -- Verification
   Staffing: 0.8 FTE engineer, 0.6 FTE scientist – $300K
   Equipment: 5K
   Travel: 4K
   Total – $309K

NCAR Division: RAL
Project Title: Prototype Plan for Improving the 0-6 Hour Icing Forecast
NCAR PI(s): Marcia Politovich
NCAR Proposal # 2006-086
Period of Performance: 02/01/06 - 04/30/07
Date: 12/9/05
Initials: DMS

		YEAR 1 JPDO	YEAR 2 JPDO	Overall Total
SALARIES & BENEFITS				
Regular Salaries				
ASSOC SCIENTIST IV		7,219	7,436	14,655
SOFT ENG/PROG II		15,839	10,876	26,715
ASSOC SCIENTIST II		12,951	10,671	23,622
PROJ SCIENTIST III		4,420	4,552	8,972
SUBTOTAL		40,429	33,535	73,964
Regular Benefits @	0.488	19,729	16,365	36,094

MATERIALS & SUPPLIES				
Misc.		500	300	800
SUBTOTAL		500	300	800
PURCHASED SERVICES				
Misc.		400	200	600
SUBTOTAL		400	200	600
TRAVEL				
Domestic		4,000	4,000	8,000
SUBTOTAL		4,000	4,000	8,000
SUBTOTAL Modified Total Direct Costs (MTDC)		65,058	54,400	119,458
NCAR INDIRECT COSTS (IC) @	0.506	32,920	27,526	60,446
MTDC Items that include IC				
COMPUTING SERVICE CENTER		7,156	5,620	12,776
TOTAL MTDC + Applied IC		105,134	87,546	192,680
UCAR Management Fee				
(Applied to MTDC + IC)	0.03	3,154	2,626	5,780
Exclusions from MTDC				
EQUIPMENT				
Equipment		12,000	0	12,000
TOTAL Funding to UCAR		120,288	90,172	210,460